ULTRASONIC SENSING SYSTEM FOR DETECTION OF PIPE SURFACE DEFORMATION

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To my beloved family, my father Zahidin Bin Ali, my mother Nor Aiti Binti Mat Ali, my brothers Nur Syahmi, Nur Syahir, Nur Syakir and Nur Syafiq.

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ABSTRACT

The utilisation of ultrasonic is widely applied for strain measurement. However, most of the measurements are performed using strain gages. The method used in this research made use of reflected signal using air as its working medium. The purpose of this experiment is to provide an alternative to the strain gage. Ultrasonic wave from transmitter transducer is transmitted to a point, and then reflected by the surface medium which experienced strain towards the ultrasonic receiver transducer. Aluminum probe cones attached to both ultrasonic transducers collimate the transmission and reception of the signals. The strain experienced by a PVC pipe is measured by the ultrasonic transducer. The difference in distance resulted in the difference of the ultrasonic wave as well as the electrical signal. When the strain started to deform, the length of deformation increased and the electric signal became weak due to the reduction of sound intensity. The received electric signal due to this change will undergo signal conditioning consisting of pre-amplifier, amplifier, band-pass filter and rectifier before being displayed onto the oscilloscope screen. There are two types of strain measured in this experiment: tensile and compression strain. The result is consistent throughout the experiment. An experiment using a strain gage and an experiment on the deflection measurement were also carried out to determine the value of strain due to deformation. From these two experiments, the relationship between strain formation created and sound intensity rate which relies on voltage change can thus be identified.

ABSTRAK

Penggunaan ultrasonik dalam bidang pengukuran terikan semakin meluas digunakan pada masa kini. Walau bagaimanapun, kebanyakan pengukuran terikan masih menggunakan tolok terikan. Kaedah yang digunakan dalam kajian ini menggunakan konsep isyarat terpantul yang menjadikan udara sebagai medium kerja. Tujuan eksperimen ini adalah untuk mengemukakan alternatif baru bagi menggantikan penggunaan tolok terikan. Gelombang ultrasonik dari transduser pemancar akan ditala menuju ke satu titik, kemudian akan dipantulkan semula oleh permukaan yang mengalami terikan ke transduser penerima. Satu corong yang diperbuat dari alumunium dipasang pada kedua-dua transduser untuk memudahkan proses penerimaan dan pemancaran gelombang. Terikan yang dialami oleh sebuah paip PVC (Polivinil Klorida) diukur oleh transduser ultrasonic tersebut. Perbezaan jarak mengakibatkan perbezaan pada penerimaan gelombang bunyi dan isyarat elektrik. Apabila terikan tegasan berlaku, jarak terikan menjadi lebih panjang dan isyarat elektrik menjadi lemah kerana kekuatan bunyi berkurangan. Isyarat elektrik yang terhasil dari perubahan ini akan melalui proses penyesuaian isyarat pra-penguat, penguat, penapis, dan penerus sebelum disambungkan ke papan pemuka osiloskop. Dua jenis terikan yang diukur di dalam ujikaji ini: terikan tegangan dan juga terikan tekanan. Keputusan kajian menunjukkan alat ini memberi pola bacaan yang seragam dan konsisten. Eksperimen menggunakan tolok terikan dan eksperimen lenturan dilakukan juga untuk mengukur nilai terikan yang terbentuk. Melalui kedua-dua eksperimen ini, maka satu bentuk hubungan antara jarak terikan yang terhasil dan kadar kekuatan bunyi yang bersandarkan pada perubahan voltan boleh dikenalpasti.